500mA High PSRR, Low Noise, Low Power LDO

Features

- Input Voltage Range: 2V to 5.5V
- Output Voltage Range: 1.1V to 4.5V
- Output Voltage Tolerance: ±2%
- Low Shutdown Current: 0.1μA (Typ.)
- Low Power Consumption: 28μA (Typ.)
- Low Dropout: @100mA
- High PSRR: 70dB@1KHz (Typ.)
- Over Current Protection
- Short Circuit Protection
- Thermal Shutdown Protection
- –40°C to 125°C Operating Junction Temperature
- SOT23-5/ SOT23-3/DFN4-1×1 Package

Applications

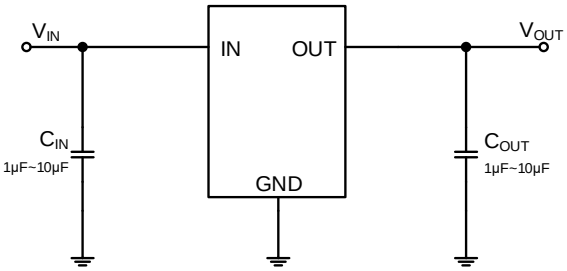
- Mobile Phones, Tablets
- Portable Medical Equipment
- IP Cameras
- Digital Cameras and Audio Devices
- Portable and Battery-Powered Equipment
- Drones

General Description

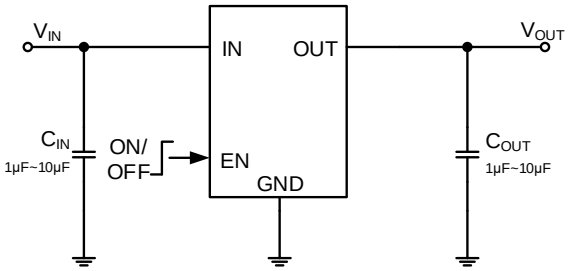
The RY6050 series are highly accurate, low noise, CMOS LDO Voltage Regulators. Offering low output noise, high ripple rejection ratio, low dropout and very fast turn-on times. The RY6050's current limiters' feedback circuit also operates as a short protect for the output current limiter and the output pin. The output voltage is set by current trimming. Voltages are selectable in 50mV steps within a range of 1.1V to 4.5V.

The RY6050 series is also fully compatible with low ESR ceramic capacitors, reducing cost and improving output stability. This high level of output stability is maintained even during frequent load fluctuations, due to the excellent transient response performance and high PSRR achieved across a broad range of frequencies. The EN function allows the output of regulator to be turned off, resulting in greatly reduced power consumption. The RY6050 series are available in SOT23-3, SOT23-5, DFN4-1×1 package.

Typical Application Circuit



SOT23-3 Typical Application Circuit



SOT23-5/DFN1×1-4 Typical Application Circuit

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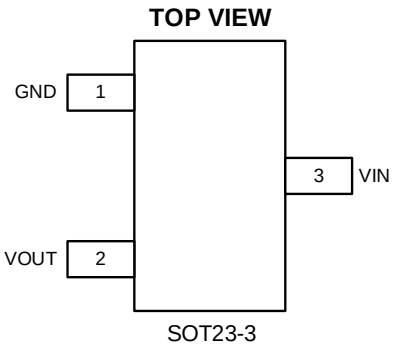
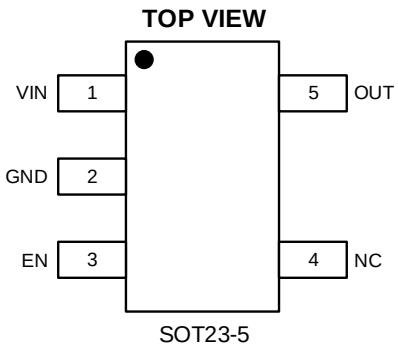
Pin Description

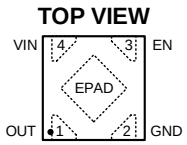
Pin Configuration



SOT23-3



SOT23-5



DFN1×1-4

Pin Description

SOT23-3 Pin No.	SOT23-5 Pin No.	DFN1×1-4 Pin No.	Pin Name	Function
3	1	4	VIN	Input voltage pin for the regulator.
1	2	2	GND	Ground pin.
-	3	3	EN	Enable Control (Active high), Driving EN over 0.9 V turns on the regulator. Driving EN below 0.4 V puts the regulator into shutdown mode.
-	4	-	NC	Not Connected.
2	5	1	OUT	Output voltage pin for the regulator.
-	-	EPAD	EPAD	Exposed pad should be connected directly to the GND pin.

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Order Information (1)

RY6050-①②③④

Designator	Symbol	Description		
①②	Integer	Output Voltage		
③	M3	SOT23-3		
	M5	SOT23-5		
	D4	DFN1×1-4		
④	R	RoHS / Pb Free		
Part No.	**Model**	**Description**	**Package**	**T/R Qty**
70606120	RY6050-11M3R	RY6050-11M3R High PSRR LDO, 1.1V, SOT23-3	SOT23-3	3000PCS
70606121	RY6050-12M3R	RY6050-12M3R High PSRR LDO, 1.2V, SOT23-3	SOT23-3	3000PCS
70606122	RY6050-15M3R	RY6050-15M3R High PSRR LDO, 1.5V, SOT23-3	SOT23-3	3000PCS
70606123	RY6050-18M3R	RY6050-18M3R High PSRR LDO, 1.8V, SOT23-3	SOT23-3	3000PCS
70606124	RY6050-25M3R	RY6050-25M3R High PSRR LDO, 2.5V, SOT23-3	SOT23-3	3000PCS
70606125	RY6050-28M3R	RY6050-28M3R High PSRR LDO, 2.8V, SOT23-3	SOT23-3	3000PCS
70606126	RY6050-30M3R	RY6050-30M3R High PSRR LDO, 3.0V, SOT23-3	SOT23-3	3000PCS
70606127	RY6050-33M3R	RY6050-33M3R High PSRR LDO, 3.3V, SOT23-3	SOT23-3	3000PCS
70606128	RY6050-36M3R	RY6050-36M3R High PSRR LDO, 3.6V, SOT23-3	SOT23-3	3000PCS
70606129	RY6050-38M3R	RY6050-38M3R High PSRR LDO, 3.8V, SOT23-3	SOT23-3	3000PCS
70606130	RY6050-40M3R	RY6050-40M3R High PSRR LDO, 4.0V, SOT23-3	SOT23-3	3000PCS
70606131	RY6050-42M3R	RY6050-42M3R High PSRR LDO, 4.2V, SOT23-3	SOT23-3	3000PCS
70606100	RY6050-11M5R	RY6050-11M5R High PSRR LDO, 1.1V, SOT23-5	SOT23-5	3000PCS
70606101	RY6050-12M5R	RY6050-12M5R High PSRR LDO, 1.2V, SOT23-5	SOT23-5	3000PCS
70606102	RY6050-15M5R	RY6050-15M5R High PSRR LDO, 1.5V,	SOT23-5	3000PCS

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		SOT23-5		
70606103	RY6050-18M5R	RY6050-18M5R High PSRR LDO, 1.8V, SOT23-5	SOT23-5	3000PCS
70606104	RY6050-25M5R	RY6050-25M5R High PSRR LDO, 2.5V, SOT23-5	SOT23-5	3000PCS
70606105	RY6050-28M5R	RY6050-28M5R High PSRR LDO, 2.8V, SOT23-5	SOT23-5	3000PCS
70606106	RY6050-30M5R	RY6050-30M5R High PSRR LDO, 3.0V, SOT23-5	SOT23-5	3000PCS
70606107	RY6050-33M5R	RY6050-33M5R High PSRR LDO, 3.3V, SOT23-5	SOT23-5	3000PCS
70606108	RY6050-36M5R	RY6050-36M5R High PSRR LDO, 3.6V, SOT23-5	SOT23-5	3000PCS
70606109	RY6050-38M5R	RY6050-38M5R High PSRR LDO, 3.8V, SOT23-5	SOT23-5	3000PCS
70606110	RY6050-40M5R	RY6050-40M5R High PSRR LDO, 4.0V, SOT23-5	SOT23-5	3000PCS
70606111	RY6050-42M5R	RY6050-42M5R High PSRR LDO, 4.2V, SOT23-5	SOT23-5	3000PCS
70606120	RY6050-11D4R	RY6050-11D4R High PSRR LDO, 1.1V, DFN1×1-4	DFN1×1-4	5000PCS
70606121	RY6050-12D4R	RY6050-12D4R High PSRR LDO, 1.2V, DFN1×1-4	DFN1×1-4	5000PCS
70606122	RY6050-15D4R	RY6050-15D4R High PSRR LDO, 1.5V, DFN1×1-4	DFN1×1-4	5000PCS
70606123	RY6050-18D4R	RY6050-18D4R High PSRR LDO, 1.8V, DFN1×1-4	DFN1×1-4	5000PCS
70606124	RY6050-25D4R	RY6050-25D4R High PSRR LDO, 2.5V, DFN1×1-4	DFN1×1-4	5000PCS
70606125	RY6050-28D4R	RY6050-28D4R High PSRR LDO, 2.8V, DFN1×1-4	DFN1×1-4	5000PCS
70606126	RY6050-30D4R	RY6050-30D4R High PSRR LDO, 3.0V, DFN1×1-4	DFN1×1-4	5000PCS
70606127	RY6050-33D4R	RY6050-33D4R High PSRR LDO, 3.3V, DFN1×1-4	DFN1×1-4	5000PCS
70606128	RY6050-36D4R	RY6050-36D4R High PSRR LDO, 3.6V, DFN1×1-4	DFN1×1-4	5000PCS
70606129	RY6050-38D4R	RY6050-38D4R High PSRR LDO, 3.8V, DFN1×1-4	DFN1×1-4	5000PCS

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70606130	RY6050-40D4R	RY6050-40D4R High PSRR LDO, 4.0V, DFN1×1-4	DFN1×1-4	5000PCS
70606131	RY6050-42D4R	RY6050-42D4R High PSRR LDO, 4.2V, DFN1×1-4	DFN1×1-4	5000PCS

Note (1): All RYCHIP parts are Pb-Free and adhere to the RoHS directive.

500mA High PSRR, Low Noise, Low Power LDO

SOT23 3 Pin/5 Pin Marking Rule (1)

Marking	Designator	Description
RVVYL	R	Product Code
	VV AD	Fixed Version Output Voltage (1.1~4.5V) Adjustable Version
	Y	Year Code
	L	Lot Number Code

DFN1×1-4 Marking Rule (1)

Marking	Designator	Description
LX VV	L	Product Code
	X	Lot Number Code
	VV	Fixed Version Output Voltage (1.1~4.5V)

Note (1): More detail information, please check PCN of RY6050 marking update.

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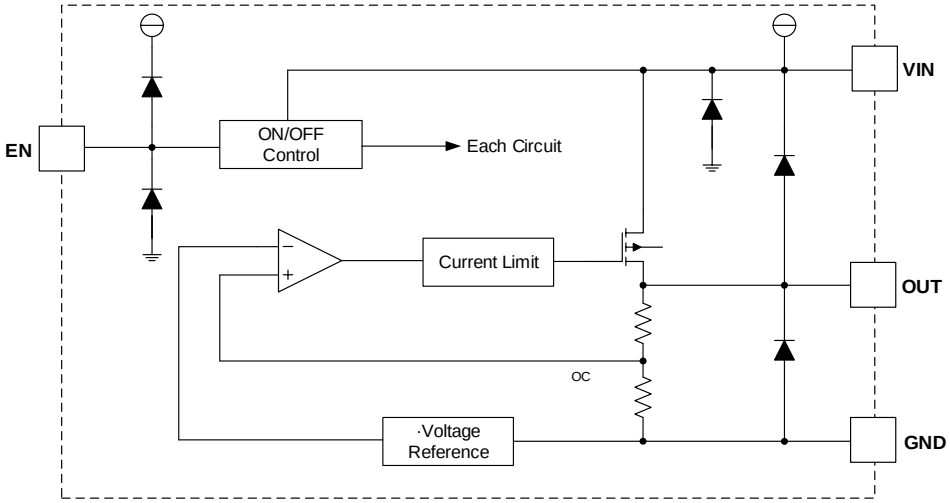
Functional Block Diagram



Functional Block Diagram

Specifications

Absolute Maximum Ratings (1) (2)

Item	Min	Max	Unit
V_{IN} voltage	2	6	V
V_{OUT} voltage	1	5	V
Output Current (3)	500		mA
Power dissipation (4)	Internally Limited		
Operating Ambient Temperature	-40	85	°C
Maximum junction temperature		150	°C
Storage temperature, T_{stg}	–50	85	°C
Lead Temperature (Soldering, 10sec.)		260	°C

Note (1): Exceeding these ratings may damage the device.

Note (2): The device is not guaranteed to function outside of its operating conditions.

Note (3): $I_{OUT}=P_D/(V_{IN}-V_{OUT})$

Note (4): The maximum allowable power dissipation is a function of the maximum junction temperature, $T_{J(MAX)}$, the junction-to-ambient thermal resistance, $R_{\theta JA}$, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D\,(MAX)} = (T_{J(MAX)} - T_A)/R_{\theta JA}$. Exceeding the maximum allowable power dissipation causes excessive die temperature, and the regulator goes into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage. Thermal shutdown engages at T_J=155°C (typical) and disengages at T_J= 140°C (typical).

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Recommended Operating Conditions

Item	Min	Max	Unit
Operating junction temperature (1)	–40	125	°C
Operating temperature range	-40	85	°C
Input voltage V_{IN}	2	5.5	V
Output current	0	500	mA

Note (1): All limits specified at room temperature (T_A = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

Thermal Information

Item	Description	SOT23 3 Pin	SOT23 5 Pin	DFN1×1 4 Pin	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance (1)(2)	208	195	216	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	112	102	161	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	56	46	162	°C/W
ψ_{JT}	Junction-to-top characterization parameter	9.2	8.5	5.1	°C/W
ψ_{JB}	Junction-to-board characterization parameter	52	45	162	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	123	°C/W

Note (1): The package thermal impedance is calculated in accordance to JESD 51-7.

Note (2): Thermal Resistances were simulated on a 4-layer, JEDEC board

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Electrical Characteristics (1)

T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Test Conditions			Min	Typ.	Max	Units
Input Voltage	V_{IN}				2		5.5	V
Output Voltage	V_{OUT}	V_{IN}=V_{OUT}+1V I_{OUT}=1mA to 500mA			V_{OUT}×0.98		V_{OUT}×1.02	V
Output Current	I_{OUT}	V_{IN}≥$V_{OUT(S)}$+1.0V				500		mA
Output Current Limit	I_{CL}	V_{IN}=5V, 1.8V<V_{OUT}<3.3V			450	500	550	mA
Dropout Voltage V_{OUT}=0.98V_{OUT} (NOM)	V_{drop}	-40°C≤T_J≤125°C	3.3V	100mA		60		mV
				300mA		230		
			2.5V	100mA		70		
				300mA		250		
			1.2V	100mA		430		
				300mA		700		
Line Regulations	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	$V_{OUT(S)}$+0.5 V≤V_{IN}≤7V I_{OUT}=300mA			-	0.20	0.60	%/V
Load Regulation	$\frac{\Delta V_{OUT}}{V_{OUT}}$	V_{IN}=$V_{OUT(S)}$+1.0 V			-	0.50	2	%
Supply current	I_{SS1}	V_{IN}=$V_{OUT(S)}$+1.0 V			-	28		μA
Shutdown Current	I_{SD}	V_{EN}=0.3V (Disable)				0.1		μA
Power Supply Rejection Ratio	PSRR	V_{OUT}=2.5V,	f = 1KHz		-	70	-	dB
		I_{OUT}=20mA	f = 10kHz			60	-	dB
Short-Circuit Current Limit	I_{SC}					500	-	mA
High Input Threshold	V_{ENH}	VEN rising until the output is enabled			0.9			V
Low Input Threshold	V_{ENL}	VEN falling until the output is disabled					0.4	V
Input Current at EN pin	I_{EN}	V_{IN}=V_{EN}=$V_{OUT(T)}$+1V			-0.1		0.1	μA
		V_{IN}=$V_{OUT(T)}$+1V, V_{EN}=V_{SS}			-0.1		0.1	μA
Thermal Shutdown Temperature	T_{SD}	T_J rising				155		°C
Thermal Shutdown Hysteresis	ΔT_{SD}	T_J falling from shutdown				15		°C

Note (1): All of specification is verified by design.

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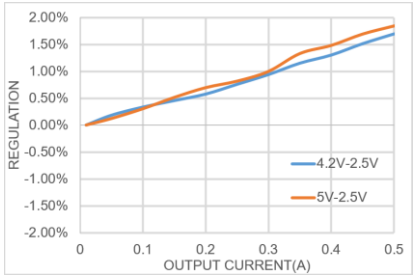
Typical Performance Characteristics (1)

Note (1): Typical performance characteristics below based on T_A = 25°C, unless otherwise noted.

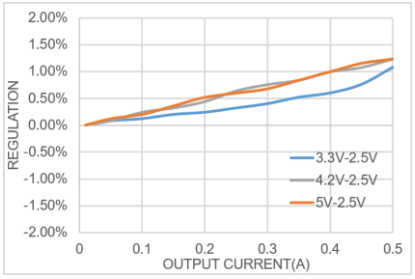
Load Regulation

V_{OUT}=3.3V



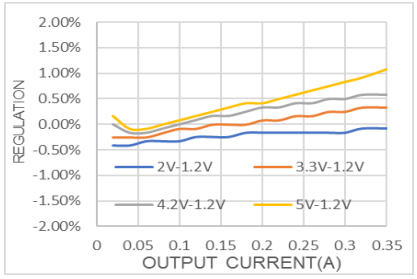
Load Regulation

V_{OUT}= 2.5V



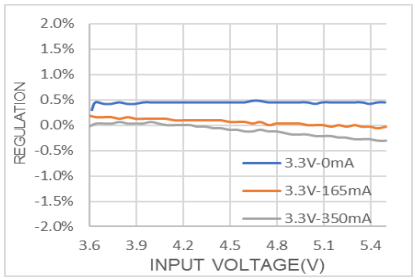
Load Regulation

V_{OUT}=1.2V



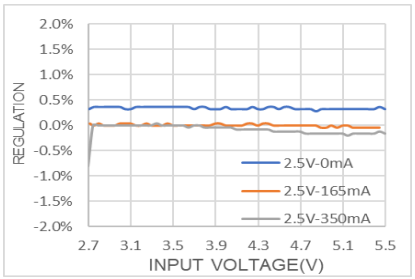
Line Regulation

V_{OUT}=3.3V



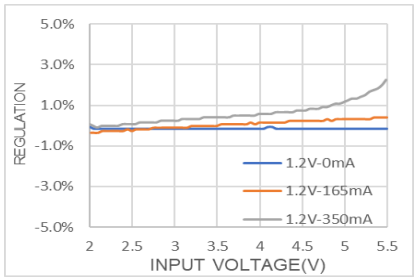
Line Regulation

V_{OUT}=2.5V



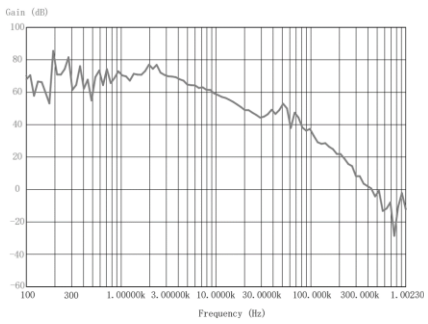
Line Regulation

V_{OUT}=1.2V



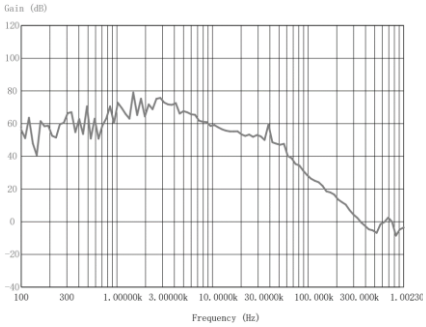
Power Supply Rejection Ration

V_{IN}=3.3V, V_{OUT}=1.2V, I_{OUT}=20mA



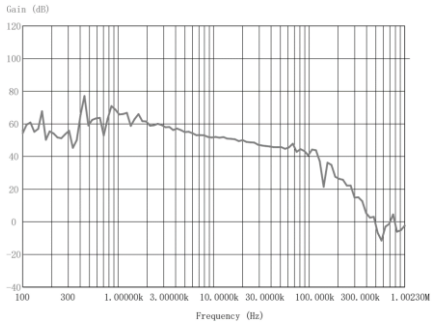
Power Supply Rejection Ration

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=20mA



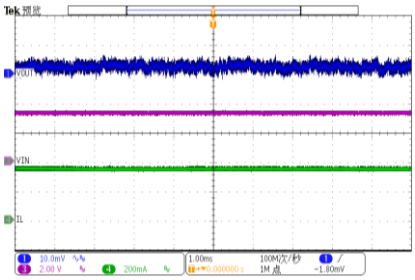
Power Supply Rejection Ration

V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=20mA



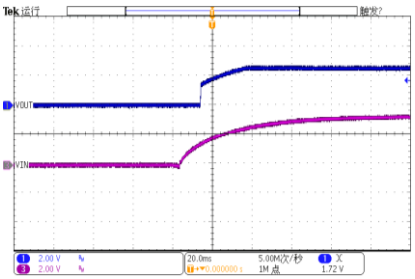
Steady State

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=350mA



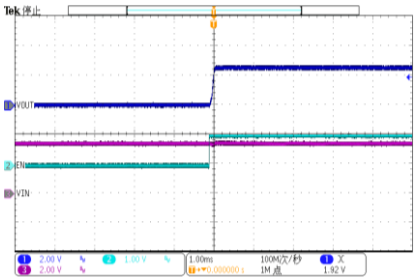
Vin Start Up

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=1mA



EN Start Up

V_{IN}=3.3V, V_{OUT}=2.5V, I_{OUT}=1mA



500mA High PSRR, Low Noise, Low Power LDO

Applications Information

Internal Current Limit and Short-Circuit Protection

The RY6050 series includes a combination of a fixed current limiter circuit & a feedback circuit, which aid the operations of the current limiter and circuit protection. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop-in output voltage, the feedback circuit operates, output voltage drops further and output current decreases.

Thermal Shutdown Protection (T_{SD})

Thermal shutdown disables the output when the junction temperature rises to approximately 160°C which allows the device to cool. When the junction temperature cools to approximately 145°C, the output circuitry enables. Based on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This thermal cycling limits the dissipation of the regulator and protects it from damage as a result of overheating. The thermal shutdown circuitry of the RY6050 has been designed to protect against temporary thermal overload conditions. The T_{SD} circuitry was not intended to replace proper heat-sinking. Continuously running the RY6050 device into thermal shutdown may degrade device reliability.

Enable (EN pin)

The EN pin voltage must be higher than the V_{ENH} threshold to ensure that the device is fully enabled under all operating conditions. The EN pin voltage must be lower than the V_{ENL} threshold to ensure that the device is fully disabled and the automatic output discharge is activated.

Layout Guidelines

The dynamic performance of the RY6050 is dependent on the layout of the PCB.

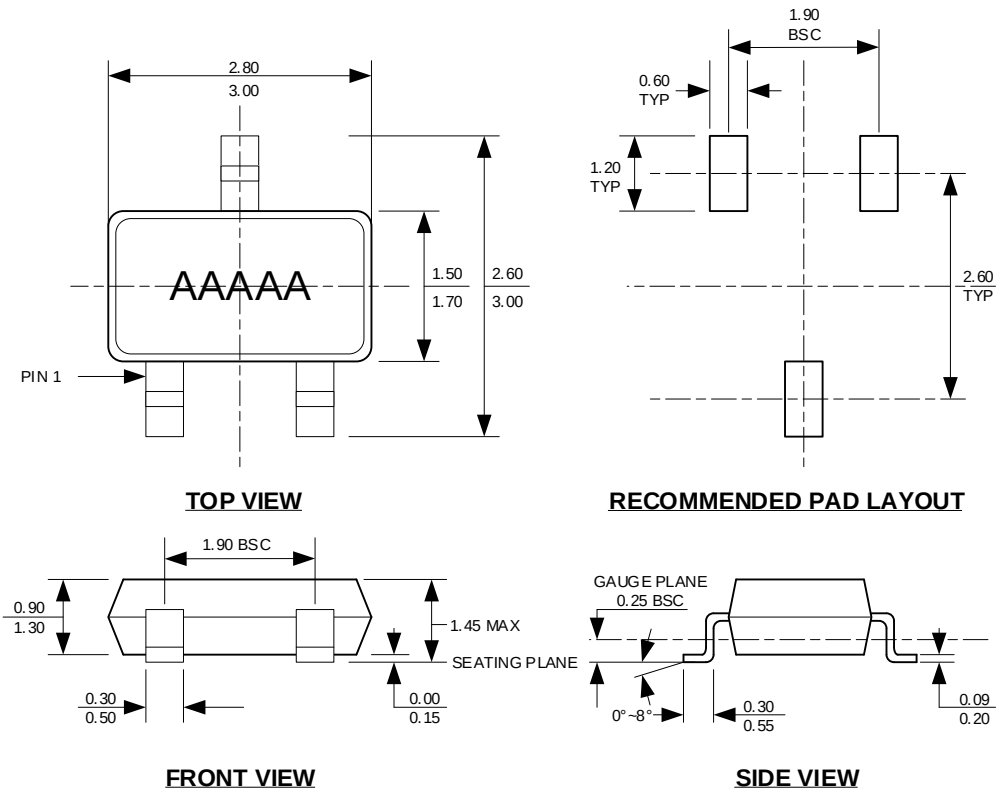
1. Best performance is achieved by placing C_{IN} and C_{OUT} as close to the IC as possible.
2. The ground connections for C_{IN} and C_{OUT} must be back to the IC's GND pin using as wide and short a copper trace as is practical.
3. Connections using long trace lengths, narrow trace widths, and/or connections through vias must be avoided. These add parasitic inductances and resistance that results in inferior performance especially during transient conditions.

500mA High PSRR, Low Noise, Low Power LDO

Packaging Information

3-Pin SOT23 Outline Dimensions

SOT23-3



NOTE:
1. CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2. PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3. PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
4. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5. DRAWING CONFORMS TO JEDEC MS-012, VARIATION BA.
6. DRAWING IS NOT TO SCALE.

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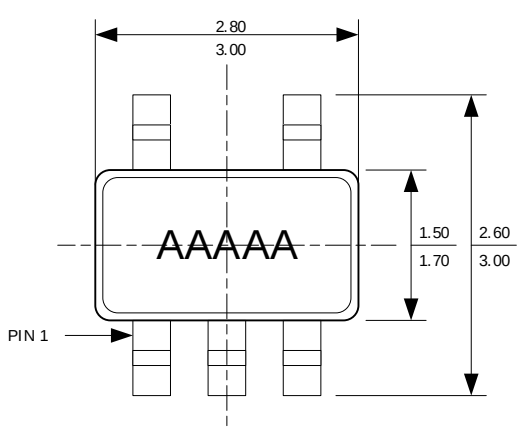
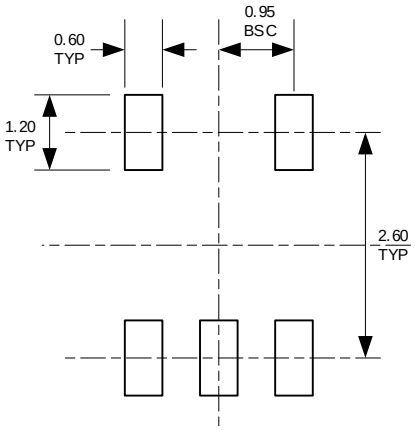
5-Pin SOT23 Packaging Information

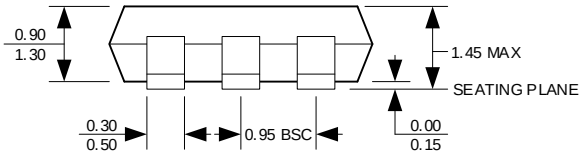
SOT23-5



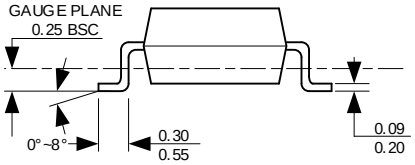
TOP VIEW



RECOMMENDED PAD LAYOUT



FRONT VIEW



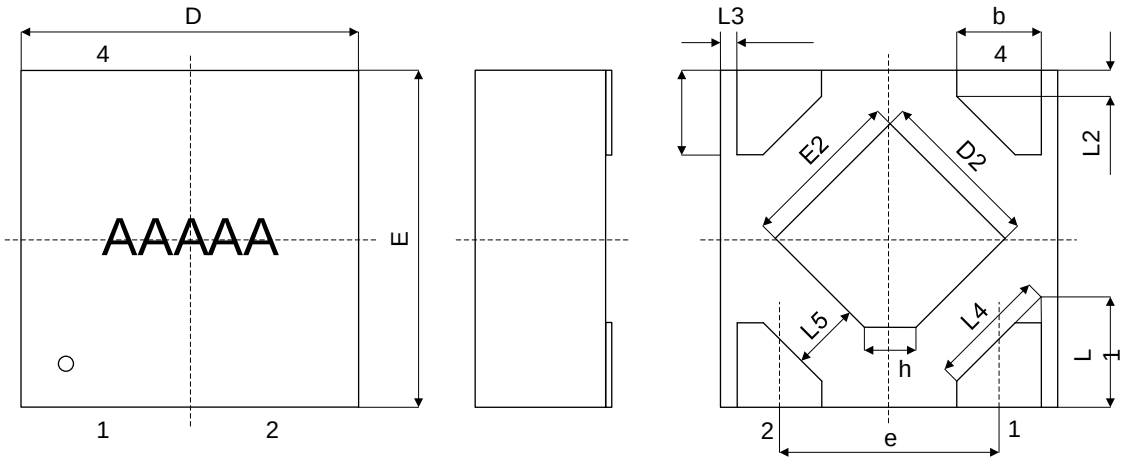
SIDE VIEW

NOTE:
1. CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2. PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3. PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
4. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5. DRAWING CONFORMS TO JEDEC MS-012, VARIATION BA.
6. DRAWING IS NOT TO SCALE.

500mA High PSRR, Low Noise, Low Power LDO

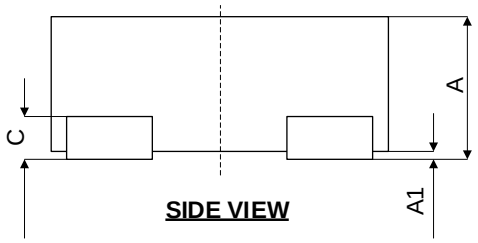
4-Pin DFN1×1 Packaging Information

DFN1x1-4



TOP VIEW

BOTTOM VIEW



SIDE VIEW

Symbol \ DIM	Min (mm)	Nom (mm)	Max (mm)
A	0.35	-	0.40
A1	0	0.02	0.05
b	0.20	0.25	0.30
c	0.02	0.07	0.17
D	0.95	1.00	1.05
D2	0.38	0.48	0.58
e	0.65BSC		
E	0.95	1.00	1.05
E2	0.38	0.48	0.58
L	0.20	0.25	0.30
L2	0.077REF		
L3	0.05REF		
L4	0.34REF		
L5	0.20REF		
h	0.12REF		

NOTE:
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3. PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
4. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5. DRAWING CONFORMS TO JEDEC MS-012, VARIATION BA.
6. DRAWING IS NOT TO SCALE.